



## MAGNETIC ENCODER WITH COVER WELDED TO REINFORCING RING

### BACKGROUND OF THE INVENTION

#### Field of the invention

[0001] The present invention relates to a magnetic encoder having a tough integrated structure, which is strong against impact as well as predominant in ~~the terms productivity of~~ productivity and ~~the~~ cost.

#### Description of the Related Art

[0002] Previously, as a magnetic encoder, taking damage due to foreign material biting and shape distortion into consideration, a magnetic encoder composed of a rubber material having ~~the magnetism and the abundant elasticity~~ has been mainly ~~used mainly~~.

[0003] Such magnetic encoder is generally formed by mixing a magnetic powder into a rubber material and placing ~~it~~ this mixture with a reinforcing ring into a mold, followed by heating, pressing, vulcanizing and adhering. Thereby, ~~the~~ a vulcanized rubber ring is fixed on the reinforcing ring. And then, the vulcanized rubber ring is magnetized circumferentially with alternate S poles and N poles.

[0004] Here, as a magnetic powder, a magnetic powder of ferrite has generally been ~~generally~~ adopted. Since a magnetic material composed of a rare earth element is inferior in ~~the terms of~~ kneading workability and ~~the~~ moldability, and has ~~the~~ high cost, it has been said that ~~the~~ a magnetic material composed of a rare earth element is not suitable for mixing into a rubber material, and it has not been generally adopted. However, paying ~~an~~ attention to a magnitude of ~~the~~ magnetic force of magnetic material composed of a rare earth element, adaptation of it has recently been studied.

[0005] Although a magnetic encoder formed of a rubber material is excellent in ~~the terms~~ of moldability, ~~it can not stand~~ the magnetic encoder cannot remain strong against impact, and, ~~during while~~ it is used and worked, or during an attaching process, ~~of it,~~ a magnetic encoder formed of a rubber material is damaged in some cases.

[0006] ~~So that~~ Accordingly, a structure in which ~~the a~~ surface of a magnetic encoder is covered with a rigid protecting cover has been developed, and put into practice.

[0007] In a structure in which a magnetic encoder is covered with a rigid protecting cover, it becomes necessary to attach and integrate ~~a the~~ protecting cover to a reinforcing ring constituting a magnetic encoder. For this reason, a manufacturing process is increased, and work is laborious. In addition, for this reason, ~~the cost~~ costs for manufacturing such products ~~is~~ are increased.

[0008] The aforementioned attachment and integration have generally been performed as follows.

[0009] One way is to make, in advance, a protecting cover into a form ~~wrapping around~~ covering a magnetized magnetic ring, and adhere and fix the protecting cover to a reinforcing ring via an adhesive.

[0010] Another way is to make, in advance, a protecting cover into a form ~~wrapping around~~ covering a magnetized magnetic ring and, at the same time, extend an edge part of the protecting cover. This extended edge part is deformed, caulked and engaged so as to fix the protecting cover to a reinforcing ring.

[0011] However, these conventional attaching and integrating methods have the following problems.

[0012] When adhering and fixing is performed using an adhesive, in some cases, an adhering force is reduced with time due to denaturation of ~~an the~~ adhesive.

[0013] In addition, when caulking and engaging are performed to fix a protecting cover to a reinforcing ring, there is a problem ~~on a~~ with regard to precision of tight attachment to a magnetic encoder. When the aforementioned extended edge part is excessively deformed in order to attain firm fixing, there is a possibility that a magnetized magnetic ring, which is ~~wrapped~~ covered by the protecting cover, is deformed and damaged. Conversely, when an edge part of a protecting cover is mildly deformed, stable integration and a strong integrated structure ~~can not~~ cannot be obtained.

[0014] Further, when caulking and engaging are performed to fix a protecting cover to a reinforcing ring, since a part of ~~a~~ the protecting cover, for example, an edge part of the protecting cover is enforced to be deformed, there arises easily an influence on other parts ~~in~~ during a working process of deformation. For example, even a magnetic pole surface of a magnetized magnetic ring is distorted. When a magnetic pole surface is distorted, a gap degree between a sensor which is disposed opposite to a magnetic encoder is deteriorated, and there arises a disorder in that a measuring precision is reduced.

## SUMMARY OF THE INVENTION

[0015] In view of the aforementioned problems of the conventional magnetic encoder, an object of the present invention is to provide a magnetic encoder having a tough integrated structure, and which is strong against impact as well as predominant in ~~the~~ terms of productivity and ~~the~~ cost.

[0016] A magnetic encoder of the present invention is used in a wheel bearing. This magnetic encoder of the present invention forms a pulse train by ~~means~~ virtue of a magnetic force, and generates a code, and ~~comprising~~ comprises a magnetic ring, a reinforcing ring, and a protecting cover.

[0017]        ~~Wherein, said~~ The magnetic ring is fixed to ~~said the~~ reinforcing ring and circumferentially magnetized with alternate S poles and N poles.

[0018]        And, ~~said the~~ protecting cover is made of a non-magnetic material and ~~wraps around said covers the~~ magnetic ring.

[0019]        Further, in the ~~before described~~ above-described magnetic encoder of the present invention, ~~it the magnetic encoder~~ is characterized in that ~~a plural number of weld-adhering parts~~ part(s) (weld(s)) are provided between an end part and/or end parts on a radial inner circumferential side and/or a radial outer circumferential side of ~~said the~~ protecting cover, and ~~said the~~ reinforcing ring.

[0020]        In the above description, a magnetic ring can be prepared by forming a ring-like shaped single magnet using a magnetic material such as ferrite or a rare earth element, and circumferentially magnetizing the said ring-like shaped single magnet with alternate S poles and N poles.

[0021]        Alternatively, a bond magnet, a cast magnet ~~and or~~ a sintered magnet may be used as the above described magnetic ring, in which a magnetic powder is mixed into a rubber material or a plastic material to form a ring, and this mixture is circumferentially magnetized ~~magnetizing it with~~ alternate S poles and N poles. In this case, as a magnetic powder, magnetic materials such as ferrite, rare earth elements, MK steel, Alnico and the like can be used.

[0022]        In the magnetic encoder of the present invention, ~~a plural number of weld-adhering parts~~ part(s) (weld(s)) are provided between an end part and/or end parts on a ~~radial~~ radially inner circumferential side and/or a ~~radial~~ radially outer circumferential side of a protecting cover, and a reinforcing ring. That is, there are ~~weld-adhered parts, weld(s)~~ which ~~are weld-adhered to join a reinforcing ring, to a protecting cover~~ at an end part and/or end parts on a ~~radial~~ radially inner circumferential side and/or ~~radial~~ radially outer circumferential side of a

the protecting cover.

[0023] ~~So that~~ Accordingly, it is not necessary to apply forced deformation in order to attach or integrate a protecting cover to a reinforcing ring, ~~thereby~~ whereby attachment and an integration process can ~~be proceeded~~ proceed easily. In addition, after attachment or integration, a distortion does not remain on a magnetic pole surface of a magnetized magnetic ring. Therefore, a gap degree between a magnetic encoder and a sensor, which is disposed opposite to a magnetic encoder, can be retained constant, and a high measurement precision can be exerted.

[0024] Further, by adopting weld-adhesion as a fixing method, more stable and firm adhesion, and integration with a reinforcing ring have become possible as compared with adhesion using an adhesive, caulking, and fixing by engagement which have conventionally been performed. In addition, an attachment precision has become higher. Further, execution itself has become easy as compared with a fixing method such as caulking.

[0025] In the aforementioned magnetic encoder of the present invention, at an end part and/or end parts on a ~~radial~~ radially inner circumferential side and/or ~~radial~~ radially outer circumferential side of a protecting cover, a ~~part which is weld-adhered to a reinforcing ring~~ may be welded to the cover over an entire circumference of ~~a the~~ the protecting cover.

[0026] Alternatively, in the aforementioned magnetic encoder of the present invention, at an end part and/or end parts on a ~~radial~~ radially inner circumferential side and/or ~~radial~~ radially outer circumferential side of a protecting cover, weld-adhesion (welding) may be performed at plural places of 3 to 6 places at a predetermined interval. When weld-adhered (welded) at plural places of 3 to 6 places, sufficient strength and firm integration can be obtained.

[0027] In the aforementioned magnetic encoder of the present invention, the aforementioned weld-adhering part (weld) is desirably formed by weld-adhering (welding) an end part and/or end parts on a ~~radial~~ radially inner circumferential side and/or a ~~radial~~ radially

outer circumferential side of a protecting cover to a reinforcing ring by performing micro-spot welding using ~~the~~ laser light. ~~The reason is that~~ This is so because, by using micro-spot welding using ~~the~~ laser light, distortion and thermal influence on parts other than a welded part can be minimized.

[0028] In order to minimize distortion and thermal influence on parts other than a welded part, for example, weld-adhesion to a reinforcing ring may be performed using a YAG laser. YAG laser refers to a laser using yttrium-~~aluminium~~aluminum-garnet crystal containing Nd.

[0029] According to the present invention, there can be provided a magnetic encoder which is hardly damaged not only when a magnetic ring having a single magnet as a magnetic material is used, but also when a magnetic ring composed of a rubber material, which is weak to impact and may be damaged ~~during it is~~ while being used and worked, or during an attaching process, is used.

[0030] In addition, in the magnetic encoder of the present invention, since a protecting cover is directly weld-adhered to a reinforcing ring, which reinforces a magnetic ring, integrity between ~~a~~ the reinforcing ring and ~~a~~ the protecting cover can be enhanced, and a tough integrated structure can be obtained.

[0031] In addition, by weld-adhesion, a high attachment precision can be realized. Since attachment of a protecting cover at a high precision leads to enhancement of a sensing precision of a magnetic sensor, a measurement precision of a magnetic encoder can be dramatically enhanced.

[0032] Further, by weld-adhesion, a manufacturing process becomes easy, and ~~the~~ productivity can be enhanced.

[0033] Due to these various effects, ~~the~~ a lower cost of a high performance magnetic encoder can be realized.

## BRIEF DESCRIPTION OF THE DRAWINGS

[0034] Fig. 1 is a partial cross-sectional view of an example in which weld-adhesion between a reinforcing ring and a protecting cover is performed on a ~~radial~~radially inner circumferential side of a magnetic encoder;

[0035] Fig. 2 is a partially exploded perspective view explaining ~~the~~a state where a magnetic ring is attached to a reinforcing ring;

[0036] Fig. 3 is a partial cross-sectional view of an example in which weld-adhesion between a reinforcing ring and a protecting cover is performed on a ~~radial~~radially outer circumferential side of a magnetic encoder; and

[0037] Fig. 4 is a partial cross-sectional view of an embodiment in which weld-adhesion between a reinforcing ring and a protecting cover is performed on a ~~radial~~radially outer circumferential side of ~~the~~a magnetic encoder, in an example in which the magnetic encoder of the present invention is adopted in a combination seal structure;

[0038] Fig. 5(a) is a partially exploded perspective view showing plural welds; and

[0039] Fig. 5(b) is a plan view showing the plural welds.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0040] Fig. 1 is a partial cross-sectional view of an example in which weld-adhesion between a reinforcing ring 2 and a protecting cover 3 is performed on a radial inner circumferential side of a magnetic encoder 6.

[0041] The magnetic encoder 6 is mounted on a wheel bearing in order to detect a ~~rotation number~~rotational amount. The magnetic encoder 6 forms a pulse train by ~~means-virtue~~ of a magnetic force, and generates a code.

[0042] A sensor (not shown) is disposed opposite to this magnetic encoder 6 (disposed

opposite to a magnetic ring 1, in an upper side, in Fig. 1), and a ~~rotation number~~ rotational amount is detected.

[0043] As shown in Fig. 1, the magnetic encoder 6 is comprised of ~~a~~the magnetic ring 1, ~~a~~the reinforcing ring 2, and ~~a~~the protecting cover 3. The magnetic ring 1 is fixed to ~~a~~the reinforcing ring 2, and ~~which is~~ circumferentially magnetized with alternate S poles and N poles as shown in Fig. 2. The protecting cover 3 is made of a non-magnetic material and ~~wraps around~~ covers the magnetic ring 1 as shown in Fig. 1.

[0044] In an embodiment shown in Fig. 1, the reinforcing ring 2 is composed of a cylindrical part 2a extending in an axial direction and a flange part 2b extending outwardly in a radial direction from an end part of this cylindrical part 2a. The magnetic ring 1 is fixed to the flange part 2b of this reinforcing ring 2 on ~~the~~an outer surface of flange part 2b in an axial direction.

[0045] In ~~an~~the embodiment shown in Fig. 1, ~~a~~the cylindrical part 2a is mounted on an outer circumference of ~~a rotating~~ an axial rotary member (e.g. axis) (not shown).

[0046] First, ~~a~~the reinforcing ring 2 is formed using a cold rolled steel plate (SPCC).

[0047] On the other hand, a single magnet of ferrite ~~are~~is formed as a ring-like shape, and ~~the said formed this~~ ring-like shape shaped single magnet of ferrite is circumferentially magnetized with alternate S poles and N poles. Thereby, ~~a~~the magnetic ring 1 as a multi-pole magnet ~~was~~is prepared.

[0048] As shown in Fig. 2, ~~a~~the magnetic ring 1 is adhered to ~~a~~the flange part 2b of the reinforcing ring 2 using an epoxy series adhesive.

[0049] Then, ~~a~~ ring-like shaped protecting cover 3 made into a form ~~wrapping around~~ covering the magnetic ring 1 is prepared using ~~aluminium~~aluminum.

[0050] A radial inner circumferential side end part of ~~a~~the protecting cover 3 is bent



toward a radial inner circumferential side as expressed by a-symbol 3c in Fig. 1. And, ~~a-the~~ protecting cover 3 is attached to ~~a-the~~ reinforcing ring 2 so that the protecting cover 3 covers ~~a~~ the magnetic ring 1.

[0051] Then, using a YAG laser, an end part of the protecting cover 3 is directly fixed to ~~a-the~~ reinforcing ring 2 by welding, at a position of a-symbol 4 in Fig. 1. ~~Although it is not~~ As shown in Fig. 5(b), weld-adhesion (welding) is ~~was~~ performed at six places circumferentially at a predetermined interval. Thereby, the magnetic encoder 6 of the present invention is manufactured.

[0052] As a result of various performance tests, it was demonstrated that ~~the-thus~~ this constructed magnetic encoder 6 has a tough integrated structure, and is excellent in ~~the-terms of~~ performance of protecting ~~a-the~~ magnetic ring 1.

[0053] In addition, since manufacturing is easy, ~~the~~-productivity is improved and, accompanied therewith, there can be provided a magnetic encoder which is also advantageous in ~~the-terms of~~ cost.

[0054] In an embodiment shown in Fig. 3, weld-adhesion (welding) to a reinforcing ring 2 is performed at a radial outer circumferential side end part of a protecting cover 3. In Fig. 3, although it is not show, weld-adhesion is performed at a position of a-symbol 4, and is performed at five places circumferentially at a predetermined interval.

[0055] Since weld-adhesion is not performed on a ~~radial~~-radially inner circumferential side, a bent part 3c is not provided at an inner circumferential side end part of ~~a-the~~ protecting cover 3, unlike the embodiment shown in Fig. 1.

[0056] Since others are the same as those of the embodiment shown in Fig. 1, explanations thereof will be omitted.

[0057] In the embodiment shown in Figs. 1 and 3, ~~a-the~~ magnetic encoder 6 was used

alone. In an embodiment shown in Fig. 4, a magnetic encoder 6 is used ~~in a~~ as part of a combination seal structure. The magnetic encoder 6 is combined with ~~other a~~ a sealing member 5. The magnetic encoder 6 and the sealing member 5 relatively rotate ~~relatively~~. The magnetic encoder 6 is used as an interrupting and sliding material for a part of a sealing material.

[0058] In ~~an the~~ embodiment shown in Fig. 4, a ~~protecting~~ cover 3 is weld-adhered (welded) to a ~~reinforcing~~ ring 2 at a radial outer circumferential side end part, as in the embodiment shown in Fig. 3.

[0059] In Fig. 4, although it is not shown, weld-adhesion (welding) is performed at a position of a ~~symbol~~ 4, and is performed at four places circumferentially at a predetermined interval.

[0060] Unlike the embodiment shown in Fig. 3, a ~~radial-radially~~ inner circumferential side end of a ~~protecting~~ cover 3 is bent toward an ~~axial-axially~~ inner-directional. ~~Whereby direction, whereby a radial-radially inner circumferential side end of a magnetic ring 1 is covered with a the protecting cover 3. So that~~ Thus, according to the embodiment shown in Fig. 4, the performance of protecting a ~~the~~ magnetic ring 1 is better ~~excellent~~ than that of the embodiment shown in ~~fig.~~ Fig. 3.

[0061] Since ~~others~~ other members are the same as those of the embodiment shown in Fig. 1, explanations thereof will be omitted.

[0062] In the aforementioned examples, a magnetic ring 1 is formed using a single magnet of ferrite, but a rare earth magnet may be used as a ~~the~~ single magnet. As the rare earth magnet, alloys combining a rare earth element such as neodymium and samarium, and cobalt, iron or the like can be used. For example, a neodymium-iron-boron alloy, and a samarium-iron-nitrogen alloy can be used.

[0063] In addition, in the above description, upon adhesion of a ~~magnetic~~ ring 1 to a

reinforcing ring 2, an epoxy series adhesive is used, but various adhesives such as cyan series, phenol series, rubber series and urethane series can be used.

[0064] Alternatively, a-magnetic ring 1 may be adhesion-fixed to a-reinforcing ring 2 without using an adhesive. For example, a magnetic powder of ferrite, or a magnetic powder of a rare earth element is mixed into a rubber material (e.g. nitrile rubber, hydrogenated nitrile rubber, acryl rubber, butyl rubber, fluorine rubber-~~etc.~~ and the like) or a plastic material, and directly vulcanization-molded with a-the reinforcing ring 2, whereby, adhesion fixing can be performed. In this case, after adhesion fixing is performed by vulcanization molding, ~~it-~~this member is magnetized circumferentially with alternate S poles and N poles to form a magnetic ring, and then, a- protecting cover 3 is attached. As the aforementioned magnetic powder of a rare earth element, a combination of neodymium (Nd), iron (Fe) and boron (B), a-or a combination of samarium (Sm), iron(Fe) and nitrogen (N) can be used.

[0065] However, as explained in the above ~~example~~ examples, when a-magnetic ring 1 is formed using a single magnet, since performance of a magnetizing process, for circumferentially magnetizing ~~circumferentially~~ with alternate S poles and N poles to form a magnetic ring, can be conducted in advance and, thereafter, adhesion-fixing may be performed to a-reinforcing ring 2 using an adhesive, ~~it is advantageous~~ advantages in the terms of attachment workability can be realized.

[0066] In the above ~~example~~ examples, a-reinforcing ring 2 is formed of a cold rolled steel (SPCC), but a plate composed of a magnetic material such as SUS 430 ~~and-or~~ the like can be used. In any event, when a magnetic material is used as a-reinforcing ring 2, since ~~the-a~~ magnetic field can be widened, and a magnetic force from a-magnetic encoder 6 can be increased, ~~it-~~this is advantageous.

[0067] In the above ~~example~~ examples, ~~aluminium~~ aluminum was adopted as a

non-magnetic material for forming a-protecting cover 3, but a plastic and a non-magnetic austenitic stainless steel, for example, SUS304 and SUS301 can be used.

[0068] In the above ~~example~~ examples, welding between a-protecting cover 3 and a reinforcing ring 2 is performed at 4 to 6 places in a circumferential direction, but since it is enough as far as firm integration is realized, welding may be performed at plural places, for example, at 3 to 6 places.

[0069] In addition, taking distortion and thermal influence on ~~the other parts~~ other than a welding parts into consideration, welding is conducted by performing YAG laser welding, but as far as distortion and thermal influence on the ~~other parts~~ other than welding parts can be minimized, ~~the~~ conventionally known welding methods such as micro-spot welding using other laser light can be used.

[0070] In the above ~~example~~ examples, ~~a rotating~~ an axial rotary member (~~e.g. rotating axis~~) (not shown) is present on a ~~radial~~ radially inner side of a-reinforcing ring 2, and a ~~the~~ reinforcing ring 2 is attached to ~~its~~ an outer circumference of the rotary member. It is natural that the magnetic encoder 6 of the present invention can also be ~~also~~-used when a ~~rotating~~ rotary member is present on a ~~radial~~ radially outer side of a-reinforcing ring 2, and a ~~the~~ reinforcing ring 2 is attached to an inner circumference of the ~~rotating~~ rotary member.

[0071] In the foregoing, preferable embodiments of the present invention have been explained by referring to attached drawings, but the present invention is not limited by such embodiments, and can be changed into various forms in ~~the~~ terms of technical scope which is grasped from the ~~description of~~ claims.

## **ABSTRACT OF THE ~~DISCLOSURE~~ DISCLOSURE**

A magnetic encoder ~~(6)~~ which is used in a wheel bearing, that forms a pulse train by ~~means-virtue~~ of a magnetic force, and generates a code, ~~comprising~~ comprises a magnetic ring (1), a reinforcing ring ~~(2)~~, and a protecting cover ~~(3)~~. The magnetic ring ~~(1)~~ is fixed to ~~said-the~~ reinforcing ring ~~(2)~~ and circumferentially magnetized with alternate S poles and N poles. The protecting cover ~~(3)~~ is made of a non-magnetic material and ~~wraps-around~~ covers the magnetic ring ~~(1)~~. A plural number of ~~weld-adhering-parts~~ welds are provided between an end part and/or end parts on a radial inner circumferential side and/or a radial outer circumferential side of the protecting cover ~~(3)~~, and the reinforcing ring ~~(2)~~.